Hearing Aid Compatibility (HAC) T-Coil Test Report

APPLICANT	: ZTE CORPORATION
EQUIPMENT	: GSM/WCDMA Dual-Mode Digital Mobile Phone
BRAND NAME	: ZTE
MODEL NAME	: Z740
FCC ID	: SRQ-Z740
STANDARD	: FCC 47 CFR §20.19 ANSI C63.19-2011
T CATEGORY	: T4

The product sample completely tested on May 24, 2013. We, SPORTON INTERNATIONAL (KUNSHAN) INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager

Testing Laboratory 2627

SPORTON INTERNATIONAL (KUNSHAN) INC.
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
HA352201B	Rev. 01	Initial issue of report	Jun. 14, 2013

1. Statement of Compliance

The Hearing Aid Compliance (HAC) maximum results found during testing for the **ZTE CORPORATION; DUT: GSM/WCDMA Dual-Mode Digital Mobile Phone; Brand Name: ZTE; Model Name: Z740** are as follows:

Reference (63.19)	Description	Verdict
8.3.1	T-Coil Coupling Field Intensity	Pass
8.3.2	Frequency Response	Pass
8.3.4	Signal Quality	T4

Band	(S+N)/N in dB	T Rating
GSM850	**40.79**	**T4**
GSM1900	**41.51**	**T4**
WCDMA Band V	**44.04**	**T4**
WCDMA Band II	**42.69**	**T4**

They are in compliance with HAC limits specified in guidelines FCC 47CFR §20.19 and ANSI Standard ANSI C63.19.

Results Summary : T Category = T4 (ANSI C63.19-2011)

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C. TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958
Test Site No.	**Sporton Site No. :** SAR01-KS

2.2 Applicant

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P. R. China

2.3 Manufacturer

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P. R. China

2.4 Application Details

Date of Start during the Test	May 24, 2013
Date of End during the Test	May 24, 2013

3. General Information

3.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
DUT Type	GSM/WCDMA Dual-Mode Digital Mobile Phone
Brand Name	ZTE
Model Name	Z740
FCC ID	SRQ-Z740
IMEI Code	861897010000294
Tx Frequency	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Antenna Type	WWAN PIFA Antenna WLAN PIFA Antenna Bluetooth: PIFA Antenna
HW Version	w9mA
SW Version	Z740V1.0.0B02
Type of Modulation	GSM: GMSK GPRS: GMSK EDGE: GMSK / 8PSK WCDMA (Rel 99): QPSK HSDPA (Rel 6): QPSK HSUPA (Rel 6): QPSK HSPA+ (Rel 7): 16QAM (Downlink Only) 802.11b: DSSS (DBPSK / DQPSK / CCK) 802.11g/n: OFDM (BPSK / QPSK / 16QAM / 64QAM) Bluetooth : GFSK Bluetooth EDR : π/4-DQPSK, 8-DPSK Bluetooth 4.0 LE: GFSK
DUT Stage	Identical Prototype

List of Accessory:

Specification of Accessory		
Battery	**Brand Name**	ZTE
	Model Name	Li3817T43P3h735044

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

List of air interfaces / frequency bands

Air Interface	Frequency Band	Voice/Data	C 63.19-2011 Tested	Concurrent connections	Reduced Power 20.19 (c)(1)
GSM	850, 1900	Voice	Yes	WCDMA, WLAN, BT	No
WCDMA	Band II, Band V	Voice	Yes	GSM ,WLAN, BT	No
WLAN	2.4GHz	Data (*)	No	GSM, WCDMA	No
BT	2.4GHz	Data	No	GSM, WCDMA	No

Note:

1. (*): The voice function maybe be activated via 3rd party software application.
2. Per KDB 285076 D01 v03r02, during T-Coil test, concurrent transmission is disabled.

3.2 Applied Standards

FCC CFR47 Part 20.19
ANSI C63.19 2011-version
FCC KDB 285076 D01v03r02

3.3 Test Conditions

3.3.1 Ambient Condition

Ambient Temperature	23 °C ± 5 °C
Relative humidity	0% < RH < 80%
Acoustic Ambient Noise	>10dB below the measurement level

3.3.2 Test Configuration

The device was controlled by using a base station emulator R&S CMU200. Communication between the device and the emulator was established by coaxial connection. The EUT was set from the emulator to radiate maximum output power during all testing.

4. Hearing Aid compliance (HAC)

FCC wireless hearing aid compatibility rules ensure that consumers with hearing loss are able to access wireless communications services through a wide selection of handsets without experiencing disabling radio frequency (RF) interference or other technical obstacles.
To define and measure the hearing aid compatibility of handsets, in CFR47 part 20.19 ANSI C63.19 is referenced. A handset is considered hearing aid-compatible for acoustic coupling if it meets a rating of at least M3 under ANSI C63.19, and A handset is considered hearing aid compatible for inductive coupling if it meets a rating of at least T3.

For inductive coupling, the wireless communication devices should be measured as below.
1) Magnetic signal strength in the audio band
2) Magnetic signal frequency response through the audio band
3) Magnetic signal to noise

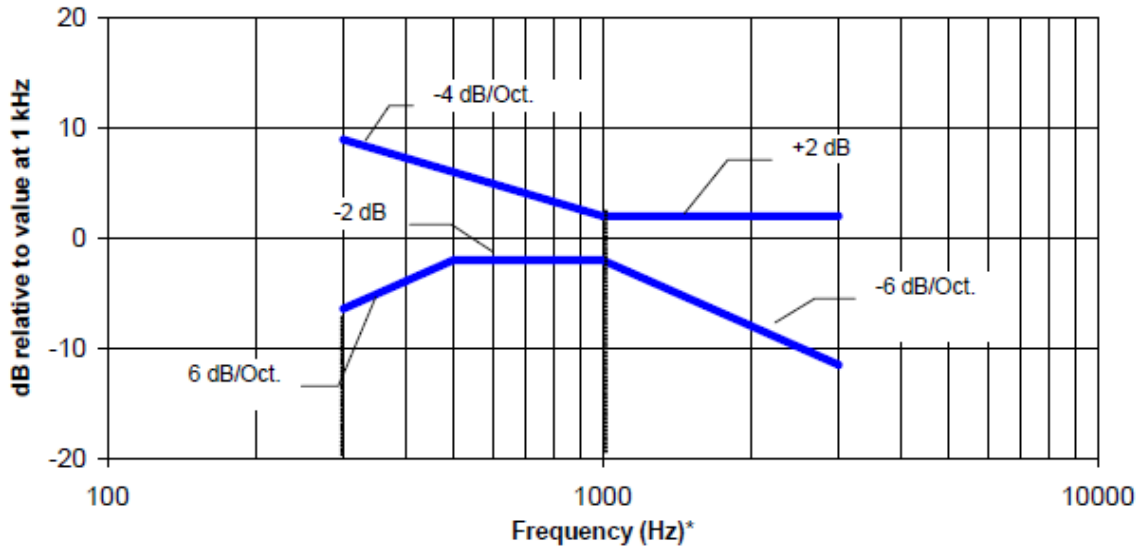
4.1 T-Coil Coupling Field Intensity

When measured as specified in this standard, the T-Coil signal shall be ≥ –18 dB (A/m) at 1 kHz, in a 1/3 octave band filter for all orientations.

4.2 T-Coil Frequency Response

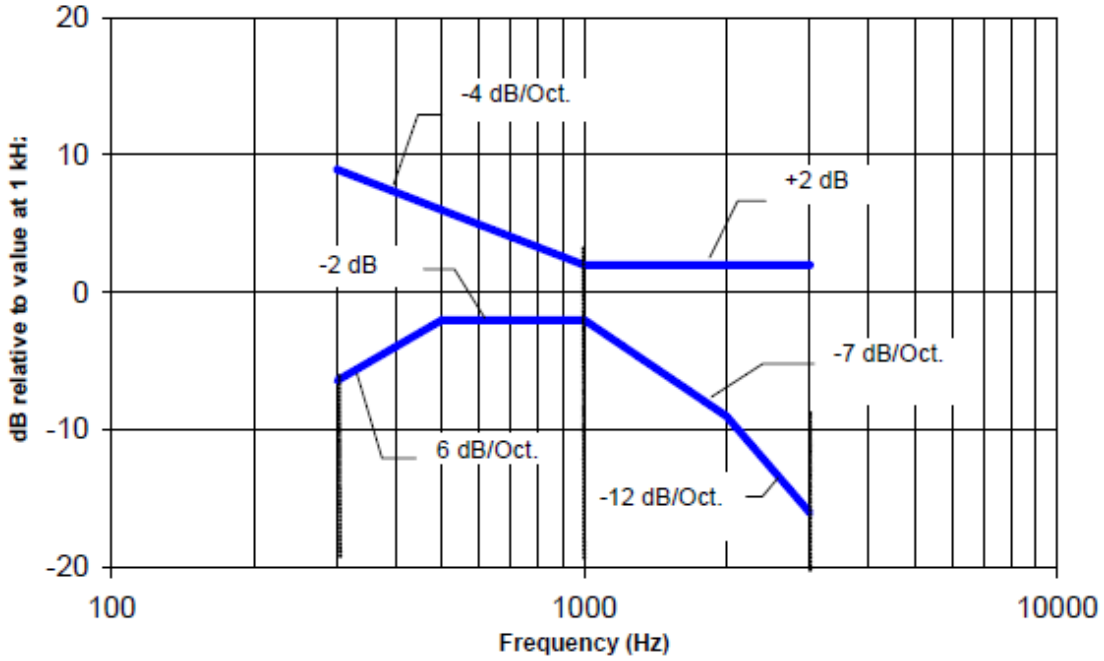
The frequency response of the perpendicular component of the magnetic field, measured in 1/3 octave bands, shall follow the response curve specified in this sub-clause, over the frequency range 300 Hz to 3000 Hz.

Figure 4.1 and Figure 4.2 provide the boundaries as a function of frequency. These response curves are for true field-strength measurements of the T-Coil signal. Thus, the 6 dB/octave probe response has been corrected from the raw readings.



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Table 4.1 Magnetic field frequency response for WDs with field strength≤-15dB at 1 KHz



NOTE—The frequency response is between 300 Hz and 3000 Hz.

Table 4.2 Magnetic field frequency response for WDs with a field that exceeds –15 dB(A/m) at 1 kHz

4.3 T-Coil Signal Quality Categories

This section provides the signal quality requirement for the intended T-Coil signal from a WD. Only the RF immunity of the hearing aid is measured in T-Coil mode. It is assumed that a hearing aid can have no immunity to an interference signal in the audio band, which is the intended reception band for this mode. A device is assessed beginning by determining the category of the RF environment in the area of the T-Coil source.

The RF measurements made for the T-Coil evaluation are used to assign the category T1 through T4. The limitation is given in Table 4.3. This establishes the RF environment presented by the WD to a hearing aid.

Category	Telephone parameters WD signal quality ((signal + noise) to noise ratio in dB)
Category T1	0 to 10 dB
Category T2	10 to 20 dB
Category T3	20 to 30 dB
Category T4	> 30 dB

Table 4.3 T-Coil Signal Quality Categories

5. HAC T-Coil Measurement Setup

5.1 System Configuration

Fig 5.1 T-Coil setup with HAC Test Arch and AMCC

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (EOC) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY software
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

5.2 AM1D Probe

The AM1D probe is an active probe with a single sensor. It is fully RF-shielded and has a rounded tip 6mm in diameter incorporating a pickup coil with its center offset 3mm from the tip and the sides. The symmetric signal preamplifier in the probe is fed via the shielded symmetric output cable from the AMMI with a 48V “phantom” voltage supply. The 7-pin connector on the back in the axis of the probe does not carry any signals. It is mounted to the DAE for the correct orientation of the sensor. If the probe axis is tilted 54.7 degree from the vertical, the sensor is approximately vertical when the signal connector is at the underside of the probe (cable hanging downwards).

Specification:

Frequency Range	0.1 ~ 20 kHz (RF sensitivity <-100dB, fully RF shielded)
Sensitivity	<-50dB A/m @ 1 kHz
Pre-amplifier	40 dB, symmetric
Dimensions	Tip diameter/ length: 6/ 290 mm, sensor according to ANSI-C63.19

5.2.1 Probe Calibration in AMCC

The probe sensitivity at 1 kHz is 0.06556 V/(A/m) (-23.66 dBV/(A/m)) was calibrated by AMCC coil for verification of setup performance. The evaluated probe sensitivity was able to be compared to the calibration of the AM1D probe. The frequency response and sensitivity was shown in Fig. 5.2. The probe signal is represented after application of an ideal integrator. The green curve represents the current though the AMCC, the blue curve the integrated probe signal. The DIFFERENCE between the two curves is equivalent to the frequency response of the probe system and shows the characteristics. The probe/system complies with the frequency response and linearity requirements in C63.19 according to the Speag's calibrated report as shown in Annex B (AM1D probe: SPAM100AF) (1)The frequency response has been tested within +/- 0.5 dB of ideal differentiator from 100 Hz to 10 kHz. (2)The linearity has also been tested within 0.1dB from 5 dB below limitation to 16 dB above noise level. The AMCC coil is qualified according to certificate report, SDHACPO02A as shown in Annex B.

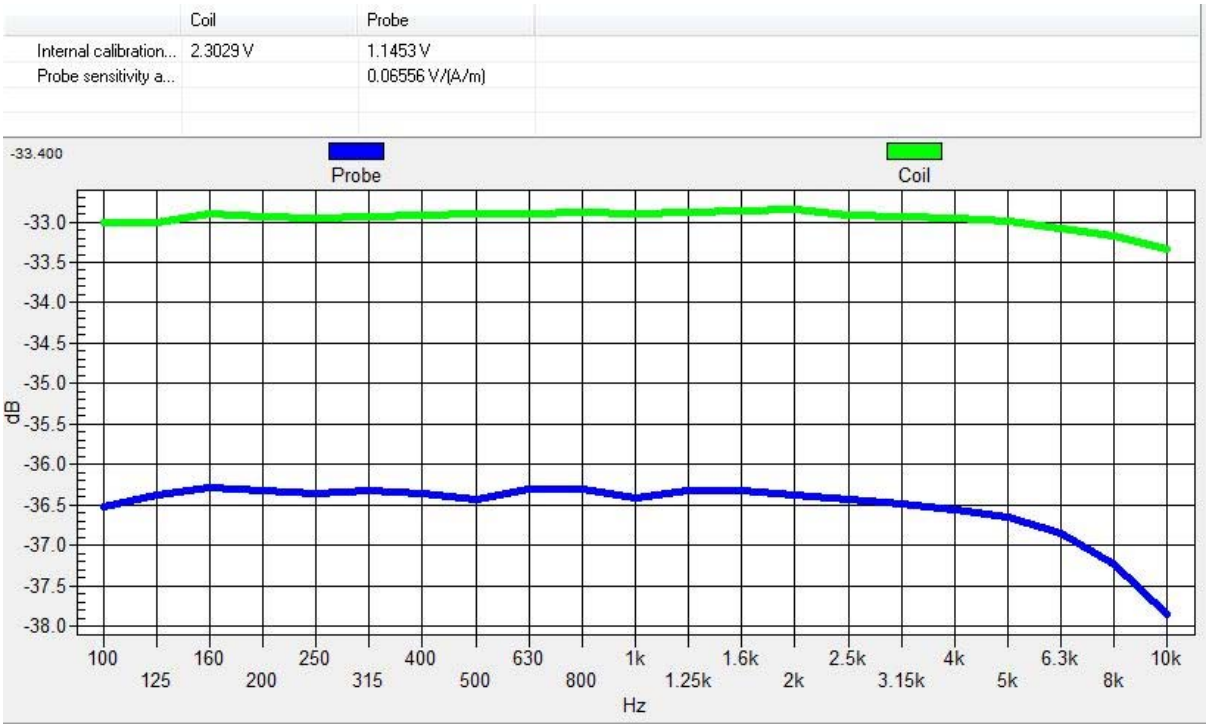


Fig 5.2 The frequency response and sensitivity of AM1D probe

5.3 AMCC

The Audio Magnetic Calibration coil is a Helmholtz Coil designed for calibration of the AM1D probe. The two horizontal coils generate a homogeneous magnetic field in the z direction. The DC input resistance is adjusted by a series resistor to approximately 50Ohm, and a shunt resistor of 10 Ohm permits monitoring the current with a scale of 1:10.

Port description:

Signal	Connector	Resistance
Coil In	BNC	typically 50 Ohm
Coil Monitor	BNO	10Ohm ±1%(100mV corresponding to 1 A/m)

Specification:

Dimensions	370 x 370 x 196 mm, according to ANSI C63.19

5.4 AMMI

Fig 5.3 AMMI front panel

The Audio Magnetic Measuring Instrument (AMMI) is a desktop 19-inch unit containing a sampling unit, a waveform generator for test and calibration signals, and a USB interface.

Specification:

Sampling rate	48 kHz/24 bit
Dynamic range	85 dB
Test signal generation	User selectable and predefined (vis PC)
Calibration	Auto-calibration/full system calibration using AMCC with monitor output
Dimensions	482 x 65 x 270 mm

5.5 DATA Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.4 Photo of DAE

5.6 Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

Fig 5.5 Photo of DASY5

5.7 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128 MB), RAM (DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig 5.6 Photo of Server for DASY5

5.8 Phone Positioner

The phone positioner shown in Fig. 5.9 is used to adjust EUT to the suitable position.

Fig 5.7 Phone Positioner

5.9 Test Arch Phantom

Construction :	Enables easy and well defined positioning of the phone and validation dipoles as well as simple teaching of the robot.
Dimensions :	370 x 370 x 370 mm

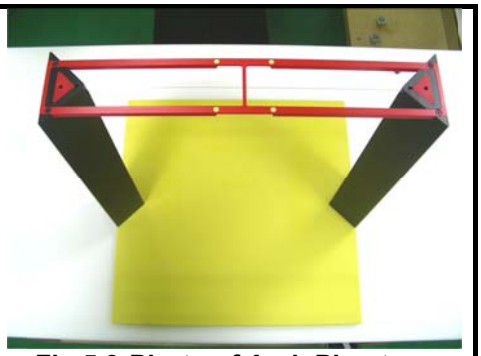


Fig 5.8 Photo of Arch Phantom

5.10 Cabling of System

The principal cabling of the T-Coil setup is shown in Fig. 5.11. All cables provided with the basic setup have a length of approximately 5 m.

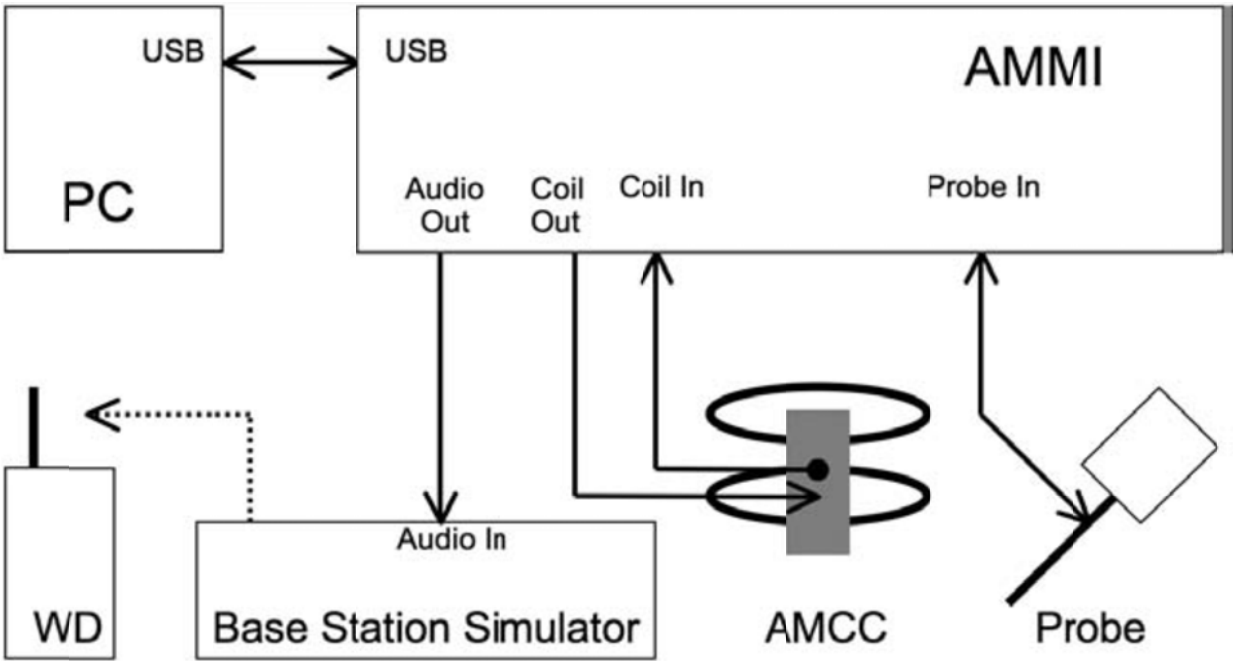


Fig 5.9 T-Coil setup cabling

5.11 HAC Extension Software

Specification:

Precise teaching	Easy teaching with adaptive distance verification
Measurement area	Flexible selection of measurement area, predefined according to ANSI C63.19
Evaluation	ABM: spectral processing, filtering, weighting and evaluation according to ANSI C63.19
Report	Documentation ready for compliance report

5.12 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Active Audio Magnetic Field probe	AM1DV3	3067	Jan.10. 2013	Jan. 09, 2014
SPEAG	Data Acquisition Electronics	DAE4	679	Jan.16. 2013	Jan. 15, 2014
SPEAG	Test Arch Phantom	Par phantom	1105	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
R&S	Universal Radio Communication Tester	CMU200	116456	Sep. 19, 2012	Sep. 18, 2013
Speag	Audio Magnetic Measuring Instrument	AMMI	1128	NA	NA
Speag	Helmholtz calibration coil	AMCC	NA	NA	NA

Table 5.1 Test Equipment List

5.13 Reference Input of Audio Signal Spectrum

With the reference job "use as reference" in the beginning of a procedure, measure the spectrum of the current when applied to the AMCC, i.e. the input magnetic field spectrum, as shown below Fig. 5.12 and Fig. 5.13. For this, the delay of the window shall be set to a multiple of the signal period and at least 2s. From the measurement on the device, using the same signal, the postprocessor deducts the input spectrum, so the result represents the net EUT response.

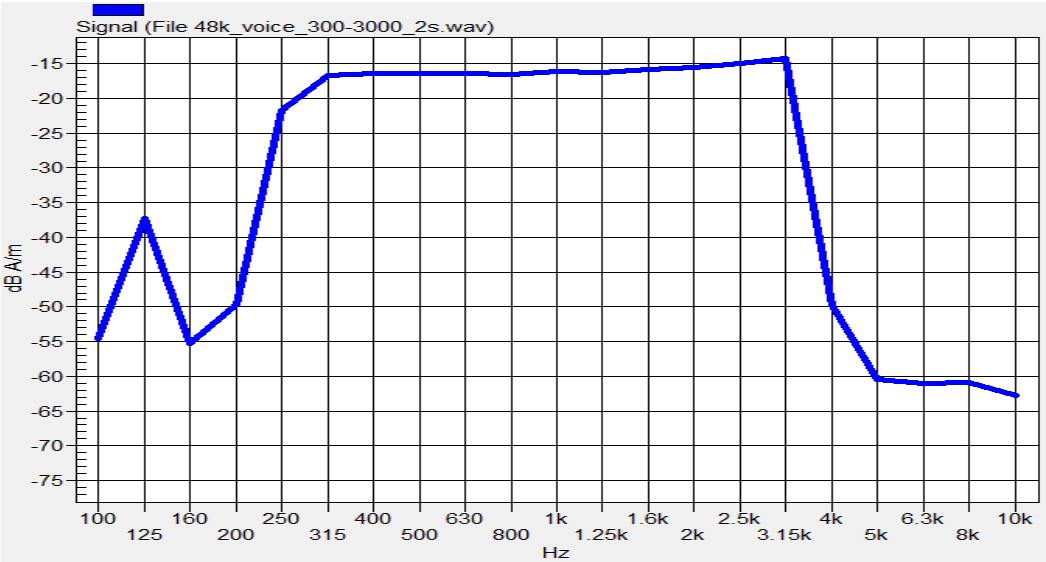


Fig. 5.12 Audio signal spectrum of the broadband signal (48kHz_voice_300Hz~3 kHz)

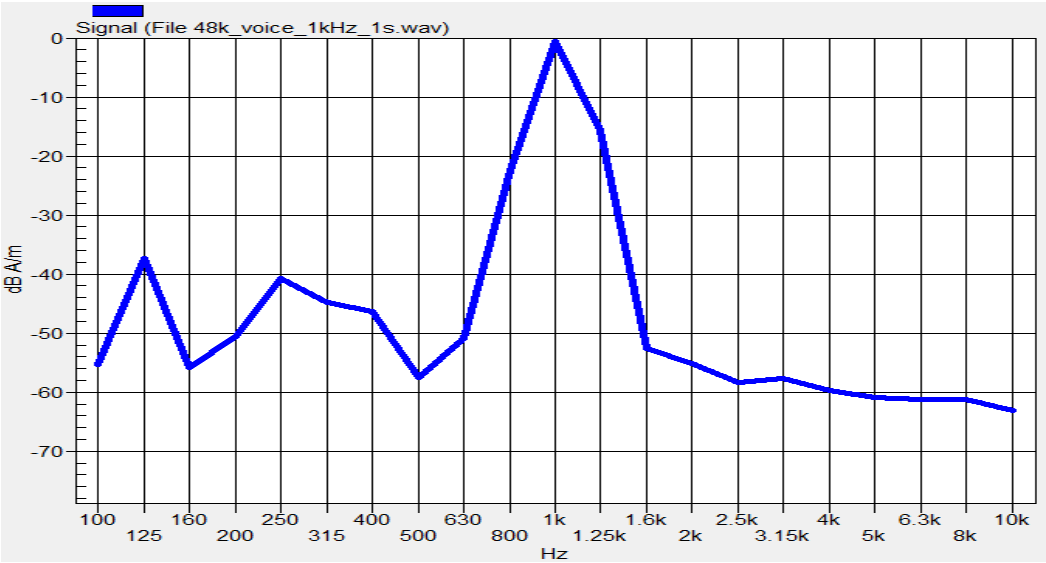


Fig. 5.13 Audio signal spectrum of the narrowband signal (48kHz_voice_1kHz)

5.14 Signal Verification

According to ANSI C63.19:2011 section 7.4.2.1, the normal speech input level for HAC T-coil tests shall be set to -16 dBm0 for GSM and UMTS (WCDMA), and to -18 dBm0 for CDMA. This technical note shows a possibility to evaluate and set the correct level with the HAC T-Coil setup with a Rohde&Schwarz communication tester CMU200 with audio option B52 and B85.

Establish a call from the CMU200 to a wireless device. Select CMU200 Network Bitstream ”Decoder Cal” to have a 1 kHz signal with a level of 3.14 dBm0 at the speech output. Run the measurement job and read the voltage level at the multi-meter display “Coil signal”. Read the RMS voltage corresponding to 3.14 dBm0 and note it.

3.14 dBm0 = -2.44 dBV

Calculate the desired signal level of -16 dBm0:

-16 dBm0 = -21.58 dBV

Determine the 1 kHz input level to generate the desired signal level of -18 dBm0. Select CMU200 Network Bitstream “Codec Cal” to loop the input via the codec to the output. Run the measurement job (AMMI 1 kHz signal with gain 10 inserted) and read the voltage level at the multimeter display “Coil signal”. Calculate the required gain setting for the above levels:

Gain 10 = -20.7 dBV

With Gain 10 setting, the measurement signal difference to the desired signal level of -16 dBm0:

-21.58 - (-20.7) = -0.88 dB

The correct gain setting is adjusted accordingly,

10 [10 ^ ((-0.88) / 20)] = 10 x 0.904 = 9.04*

The predefined signal types have the following differences / factors compared to the 1 kHz sine signal:

Signal Type	Duration (s)	Peak to RMS (dB)	RMS (dB)	Required gain factor (*)	Gain Setting
48k_voice_1kHz	1	16.2	-12.7	4.33	36.02
48k_voice_300Hz ~ 3kHz	2	21.6	-18.6	8.48	70.53

Remark:

(*) The gain for the specific signal shall typically be multiplied by this factor to achieve approx. the same level as for the 1kHz sine signal

6. Description for EUT Testing Position

Fig.6.1 illustrate the references and reference plane that shall be used in a typical EUT emissions measurement. The principle of this section is applied to EUT with similar geometry. Please refer to Appendix C for the setup photographs.

- The area is 5 cm by 5 cm.
- The area is centered on the audio frequency output transducer of the EUT.
- The area is in a reference plane, which is defined as the planar area that contains the highest point in the area of the phone that normally rests against the user's ear. It is parallel to the centerline of the receiver area of the phone and is defined by the points of the receiver-end of the EUT handset, which, in normal handset use, rest against the ear.
- The measurement plane is parallel to, and 10 mm in front of, the reference plane.

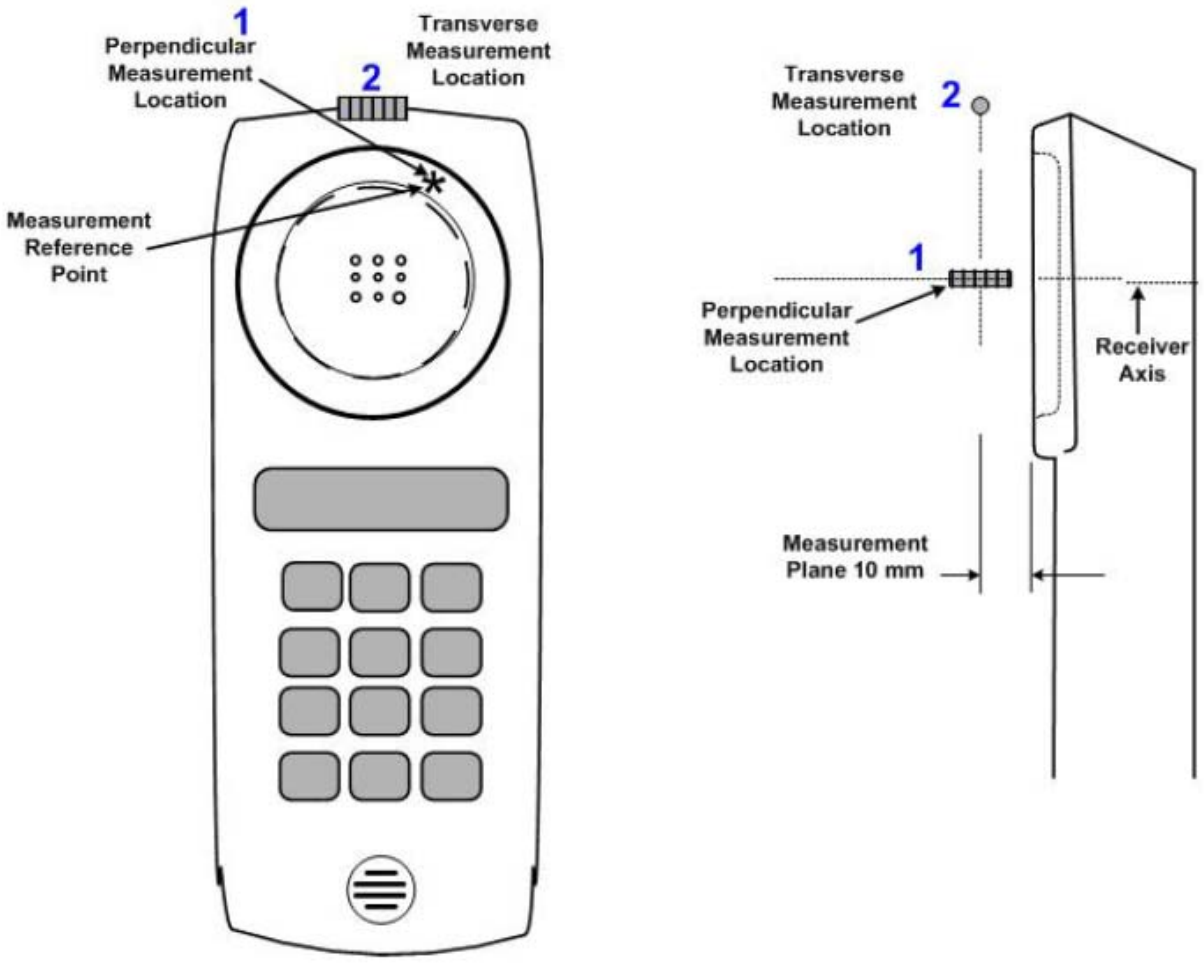


Fig 6.1 A typical EUT reference and plane for T-Coil measurements

7. T-Coil Test Procedure

Referenced to ANSI C63.19-2011, Section 7.4

This section describes the procedures used to measure the ABM (T-Coil) performance of the WD. In addition to measuring the absolute signal levels, the A-weighted magnitude of the unintended signal shall also be determined. To assure that the required signal quality is measured, the measurement of the intended signal and the measurement of the unintended signal must be made at the same location for each measurement position. In addition, the RF field strength at each measurement location must be at or below that required for the assigned category.

Measurements shall not include undesired properties from the WD's RF field; therefore, use of a coaxial connection to a base station simulator or non-radiating load, there might still be RF leakage from the WD, which can interfere with the desired measurement. Pre-measurement checks should be made to avoid this possibility. All measurements shall be performed with the WD operating on battery power with an appropriate normal speech audio signal input level given in ANSI C63.19-2011 Table 7.1. If the device display can be turned off during a phone call, then that may be done during the measurement as well,

Measurement shall be performed at two locations specified in ANSI C63.19-2011 A.3, with the correct probe orientation for a particular location, in a multistage sequence by first measuring the field intensity of the desired T-Coil signal the same location as the desired ABM or T-Coil signal (ABM1), and the ratio of desired to undesired magnetic components (ABM2) must be measured at the same location as the desired ABM or T-Coil signal (ABM1), and the ratio of desired to undesired ABM signals must be calculated. For the perpendicular field location, only the ABM1 frequency response shall be determined in a third measurement stage.

The following steps summarize the basic test flow for determining ABM1 and ABM2. These steps assume that a sine wave or narrowband 1/3 octave signal can be used for the measurement of ABM1.

a) A validation of the test setup and instrumentation may be performed using a TMFS or Helmholtz coil Measure the emissions and confirm that they are within the specified tolerance.

b) Position the WD in the test setup and connect the WD RF connector to a base station simulator or a non-radiating load. Confirm that equipment that requires calibration has been calibrated, and that the noise level meets the requirements given in ANSI C63.19-2011 clause 7.3.1.

c) The drive level to the WD ise set such that the reference input level specified in ANSI C63.19-2011 Table 7.1 is input to the base station simulator (or manufacturer's test mode equivalent) in 1 kHz, 1/3 octave band. This drive level shall be used for the T-Coil signal test (ABM1) at f = 1 kHz. Either a sine wave at 1025 Hz or a voice-like signal, band-limited to the 1 kHz 1/3 octave, as defined in ANSI C63.19-2011 clause 7.4.2, shall be used for the reference audio signal. If interference is found at 1025 Hz an alternative nearby reference audio signal frequency may be used. The same drive level shall be used for the ABM1 frequency response measurements at each 1/3 octave band center frequency. The WD volume control may be set at any level up to maximum, provided that a signal at any frequency at maximum modulation would not result in clipping or signal overload.

d) Determine the magnetic measurement locations for the WD device (A.3), if not already specified by the manufacturer, as described in ANSI C63.19-2011 clause 7.4.4.1.1 and 7.4.4.2.

e) At each measurement location, measure and record the desired T-Coil magnetic signals (ABM1 at fi) as described in ANSI C63.19-2011 clause 7.4.4.2 in each individual ISO 266-1975 R10 standard 1/3 octave band. The desired audio band input frequency (fi) shall be centered in each 1/3 octave band maintaining the same drive level as determined in item c) and the reading taken for that band.

Equivalent methods of determining the frequency response may also be employed, such as fast Fourier transform (FFT) analysis using noise excitation or input-output comparison using simulated speech. The full-band integrated probe output, as specified in D.9, may be used, as long as the appropriate calibration curve is applied to the measured result, so as to yield an accurate measurement of the field magnitude. (The resulting measurement shall be an accurate measurement in dB A/m.)

All Measurements of the desired signal shall be shown to be of the desired signal and not of an undesired signal. This may be shown by turning the desired signal ON and OFF with the probe measuring the same location. If the scanning method is used the scans shall show that all measurement points selected for the ABM1 measurement meet the ambient and test system noise criteria in ANSI C63.19-2011 clause 7.3.1.

f) At the measurement location for each orientation, measure and record the undesired broadband audio magnetic signal (ABM2) as specified in ANSI C63.19-2011 clause 7.4.4.4 with no audio signal applied (or digital zero applied, if appropriate) using A-weighting and the half-band integrator. Calculate the ratio of the desired to undesired signal strength (i,e., signal quality).

g) Obtain the data from the postprocessor, SEMCAD, and determine the category that properly classifies the signal quality based on ANSI C63.19-2011 Table 8.5.

8. HAC T-Coil Test Results

8.1 Magnitude Result

Category	Telephone parameters WD signal quality ((signal + noise) to noise ratio in dB)
Category T1	0 to 10 dB
Category T2	10 to 20 dB
Category T3	20 to 30 dB
Category T4	> 30 dB

The Table 8.1 shows testing result in position coordinates which are defined as deviation from earpiece center in millimeters. Signal strength measurement scans are presented in appendix A.

Plot No.	Band	Mode	Channel	Probe Position	ABM1 (dB A/m)	ABM2 (dB A/m)	SNR (dB)	T Rating
1	GSM850	Voice (speech codec/handset low)	128	Axial (Z)	5.68	-35.50	41.18	T4
				Transversal (Y)	-3.02	-44.04	41.02	T4
2	**GSM850**	**Voice (speech codec/handset low)**	**189**	**Axial (Z)**	**6.07**	**-34.72**	**40.79**	**T4**
				Transversal (Y)	-2.53	-43.39	40.86	T4
3	GSM850	Voice (speech codec/handset low)	251	Axial (Z)	5.84	-35.36	41.20	T4
				Transversal (Y)	-2.54	-44.11	41.57	T4
4	GSM1900	Voice (speech codec/handset low)	512	Axial (Z)	6.20	-37.72	43.92	T4
				Transversal (Y)	-1.79	-43.64	41.85	T4
5	**GSM1900**	**Voice (speech codec/handset low)**	**661**	Axial (Z)	6.06	-37.19	43.25	T4
				Transversal (Y)	**-2.62**	**-44.13**	**41.51**	**T4**
6	GSM1900	Voice (speech codec/handset low)	810	Axial (Z)	6.04	-37.96	44.00	T4
				Transversal (Y)	-2.90	-44.48	41.58	T4
7	**WCDMA Band V**	**Voice (speech codec low)**	**4132**	Axial (Z)	6.91	-41.78	48.69	T4
				Transversal (Y)	**-1.53**	**-45.57**	**44.04**	**T4**
8	WCDMA Band V	Voice (speech codec low)	4182	Axial (Z)	6.97	-41.95	48.92	T4
				Transversal (Y)	-1.60	-46.37	44.77	T4
9	WCDMA Band V	Voice (speech codec low)	4233	Axial (Z)	6.90	-42.47	49.37	T4
				Transversal (Y)	-1.56	-46.08	44.52	T4
10	WCDMA Band II	Voice (speech codec low)	9262	Axial (Z)	6.93	-41.91	48.84	T4
				Transversal (Y)	-2.33	-47.35	45.02	T4
11	WCDMA Band II	Voice (speech codec low)	9400	Axial (Z)	7.00	-41.17	48.17	T4
				Transversal (Y)	-1.38	-44.14	42.76	T4
12	**WCDMA Band II**	**Voice (speech codec low)**	**9538**	Axial (Z)	6.51	-42.13	48.64	T4
				Transversal (Y)	**-1.48**	**-44.17**	**42.69**	**T4**

Table 8.1 Test Result for Various Positions

Remark:

1. There is no special HAC mode software on this EUT.
2. The volume was adjusted to maximum level and the backlight turned off during T-Coil testing.
3. Test Engineer：Jimmy Cheng

8.2 Frequency Response Plots

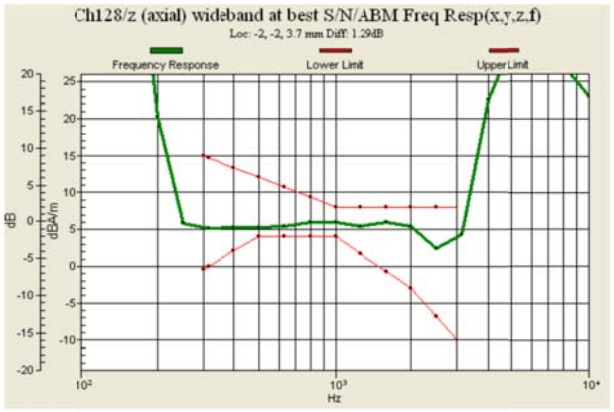


Fig 8.1 GSM850 Ch128

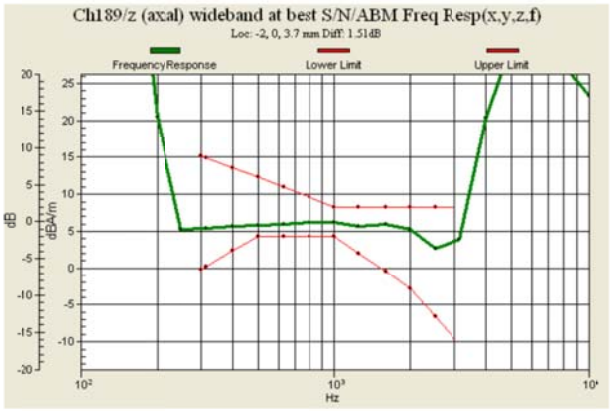


Fig 8.2 GSM850 Ch189

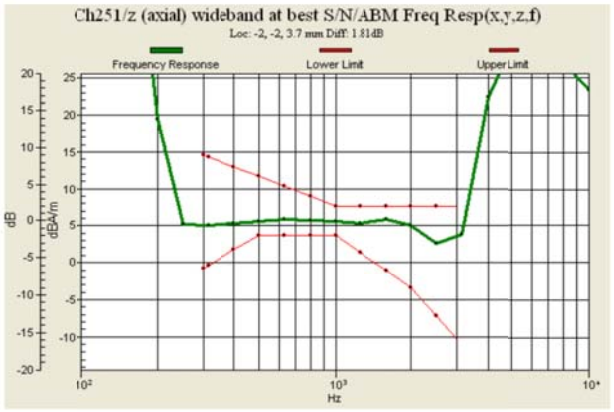


Fig 8.3 GSM850 Ch251

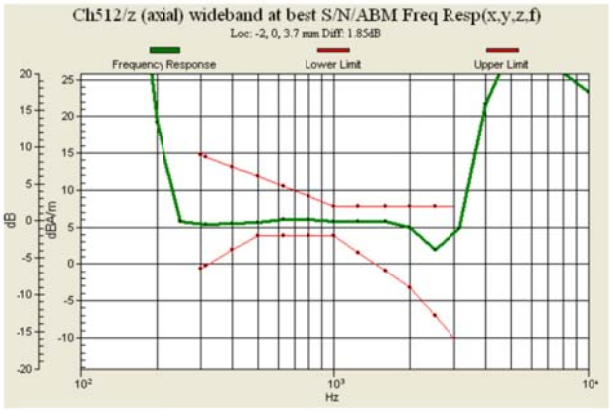


Fig 8.4 GSM1900 Ch512

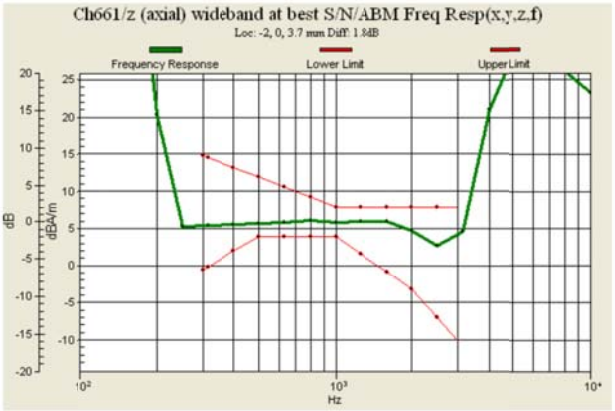


Fig 8.5 GSM1900 Ch661

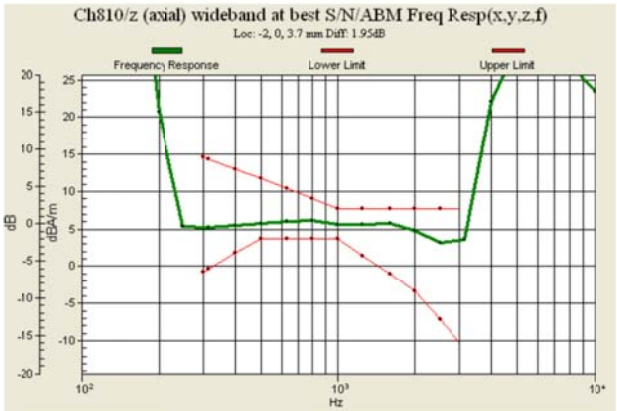


Fig 8.6 GSM1900 Ch810

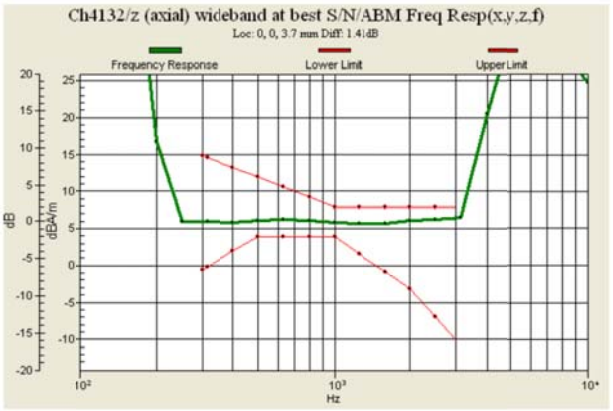


Fig. 8.7 WCDMA Band V Ch4132

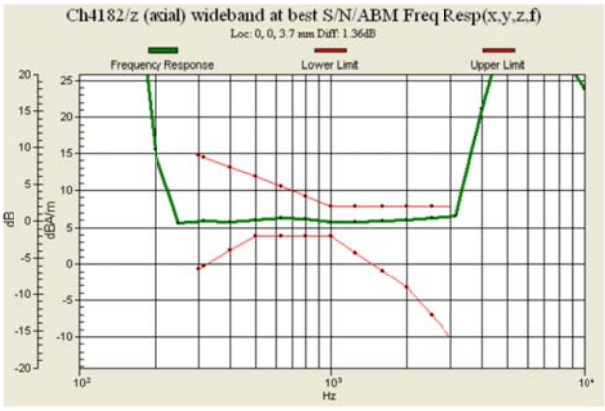


Fig. 8.8 WCDMA Band V Ch4182

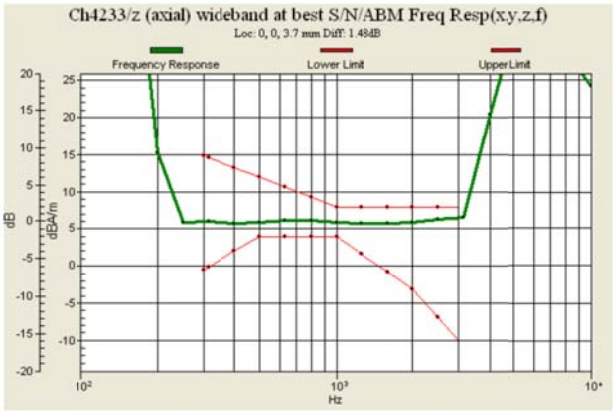


Fig. 8.9 WCDMA Band V Ch4233

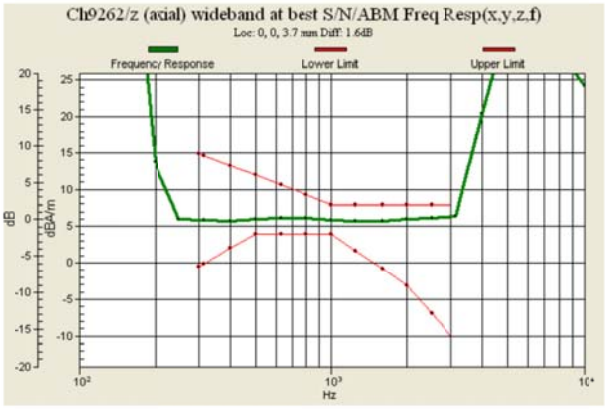


Fig. 8.10 WCDMA Band II Ch9262

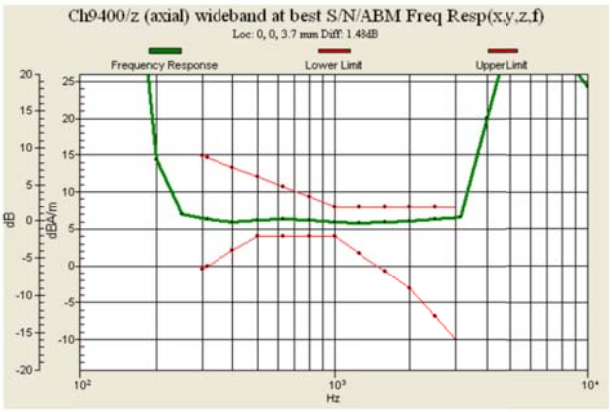


Fig. 8.11 WCDMA Band II Ch9400

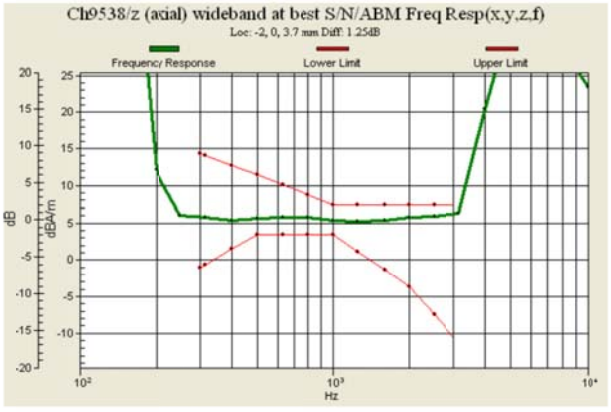


Fig. 8.12 WCDMA Band II Ch9538

9. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 9.1.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-shape
Multiplying factor[(a)]	1/k [(b)]	1/√3	1/√6	1/√2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 9.1 Multiplying Factions for Various Distributions

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 9.2.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (ABM1)	Ci (ABM2)	Standard Uncertainty (ABM1)	Standard Uncertainty (ABM2)
Probe Sensitivity							
Reference Level	3.0	Normal	1	1	1	± 3.0 %	± 3.0 %
AMCC Geometry	0.4	Rectangular	√3	1	1	± 0.2 %	± 0.2 %
AMCC Current	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Probe Positioning During Calibrate	0.1	Rectangular	√3	1	1	± 0.1 %	± 0.1 %
Noise Contribution	0.7	Rectangular	√3	0.0143	1	± 0.0 %	± 0.4 %
Frequency Slope	5.9	Rectangular	√3	0.1	1	± 0.3 %	± 3.5 %
Probe System							
Repeatability / Drift	1.0	Rectangular	√3	1	1	± 0.6 %	± 0.6 %
Linearity / Dynamic Range	0.6	Rectangular	√3	1	1	± 0.4 %	± 0.4 %
Acoustic Noise	1.0	Rectangular	√3	0.1	1	± 0.1 %	± 0.6 %
Probe Angle	2.3	Rectangular	√3	1	1	± 1.4 %	± 1.4 %
Spectral Processing	0.9	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
Integration Time	0.6	Normal	1	1	5	± 0.6 %	± 3.0 %
Field Disturbation	0.2	Rectangular	√3	1	1	± 0.1 %	± 0.1 %
Test Signal							
Reference Signal Spectral Response	0.6	Rectangular	√3	0	1	± 0.0 %	± 0.4 %
Positioning							
Probe Positioning	1.9	Rectangular	√3	1	1	± 1.1 %	± 1.1 %
Phantom Thickness	0.9	Rectangular	√3	1	1	± 0.5 %	± 0.5 %
EUT Positioning	1.9	Rectangular	√3	1	1	± 1.1 %	± 1.1 %
External Contributions							
RF Interference	0.0	Rectangular	√3	1	0.3	± 0.0 %	± 0.0 %
Test Signal Variation	2.0	Rectangular	√3	1	1	± 1.2 %	± 1.2 %
Combined Standard Uncertainty						± 4.1 %	± 6.1 %
Coverage Factor for 95 %						K = 2	
Expanded Uncertainty						**± 8.1 %**	**± 12.3 %**

Table 9.2 Uncertainty Budget of audio band magnetic measurement

10. References

[1] ANSI C63.19 2011, “American National Standard for Methods of Measurement of Compatibility between Wireless Communications Devices and Hearing Aids”, 27 May 2011

[2] SPEAG DASY System Handbook

Appendix A. Plots of T-Coil Measurement

The plots are shown as follows.

Appendix B. Calibration Data

The DASY calibration certificates are shown as follows.